



Tabletop Biosphere

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PARTS:

- Glass canning jar (1-quart)
Don't use plastic; it may bleed air.
- Plastic container (1)
Or clear bottles, for sampling and a "holding tank"
- Tap water (1)
- River rocks (1)
just enough to cover the jar bottom. Rocks piled too thick let muck and algae build up where snails and shrimp cannot eat them.
- Tap-water dechlorinator (1)
- Aquarium ornaments (1)
or other glass or ceramic obstacles. Seashells also are nice, and supply extra calcium carbonate.
- Kitchen strainer (1)
Or fine fishnet
- Freshwater minerals (1)
such as "Kent Freshwater" or "cichlid salts." These are essential trace nutrients.
- Amano shrimp (1)
aka Caridina multidentata, an algae-eater with a reputation for tolerating high pH
- Snails (4)
- Hornwort (8 stem inches)

Ceratophyllum demersum

- Duckweed (2"×2" piece)

aka Lemna. You can also collect this from a local pond.

- Calcium carbonate (1 tablespoon)

This is your primary pH buffer.

- Amphipods (8-Feb)

These are tiny crustaceans: try to collect 8, but you can use fewer.

- Pond sludge (1 or 2 Tablespoons)

hopefully containing copepods and ostracods (even tinier crustaceans), bacteria, microalgae, etc.

SUMMARY

When my 7th grade vocational aptitude test came back stamped “Forester” instead of “Astronaut,” I knew the testmakers had screwed up. Sure, I liked sitting in streams, and peering down those creepy holes by the roots of old trees. But also knew that someday the whole frickin’ park would be flying through space. Hadn’t anyone else seen Battlestar Galactica?

Now we know that space colonists are just as likely to be muddy ecologists as hotshot flyboys — the kind of people who assemble ecosystems instead of engines. Today’s pack-it-in, pack-it-out life support is impractical for long, manned missions, but in the future, regenerative systems could provide years’ worth of food, air, and water while processing human waste. It’s recycling and reuse on a radical scale, light years beyond anything pitched by those hairy guys down at the co-op.

Here’s a mini version of this dream, a sealed system that supplies a freshwater shrimp “econaut” with food, oxygen, and waste processing for a desktop journey of 3 months or more, aka the Tabletop Shrimp Support Module (TSSM).

Step 1 — Gather the aquarium supplies.



- Visit an aquarium store for the materials you'll need. While you're there, ask them how to dechlorinate local tap water for aquarium use.
- At home, dump your shrimp, snails, hornwort, duckweed, and the water they came in into an open “holding tank.” I use a plastic Tupperware or yogurt container. Add some dechlorinated tap water to keep everything comfortable (alive).

Step 2 — Collect the pond life.



- Go to a local pond. Spring and summer are best. Bring a net or bottle (or other container), and visit during late afternoon. That's when the pH is higher, like that of your TSSM.
- Find a good, shallow area of the pond to collect your goodies. If you see duckweed, water lilies, or other vascular plants, try near there. I've done well in areas with a mixture of substrates, like sand, rock, and decaying wood.
- Drag your bottle or net through mud, rocks, and half-submerged plants. Examine your take for shrimp-like creatures 1mm–10mm long. These are probably amphipods; collect up to 8 of these if you can. You need to look aggressively, getting into the muck and shaking bits of plant away. Then collect 1 or 2Tbsp of pond sludge from the pond bottom, which should contain some nearly microscopic copepods and ostracods. Back home, dump your pond samples and sludge into the holding tank.

Step 3 — Bottle it up.



- In a new container, whip up a gallon of NPFW (nitrate-poor fresh water). This is tap water, dechlorinated and supplemented with your freshwater mineral mix (follow package directions).
- NOTE: Waters from the aquarium store and pond are probably loaded with algae and algae-supporting nitrates, which will lead to algae takeover. Diluting with NPFW helps prevent this. 
- Thoroughly rinse your “fixtures” — quart canning jar, ornaments, rocks, etc. — with NPFW.

Step 4

- Fill your jar halfway with NPFW, and transfer all the ingredients to the jar, except for calcium carbonate powder, if used: shrimp, snails, hornwort, duckweed, amphipods, sludge, ornaments, rocks, seashells. Use the quantities listed. Do not put in extra animals or sludge, or otherwise mimic a traditional aquarium. What makes this system work is its sparseness.
- Fill the remaining volume of the canning jar with NPFW, leaving 1" or 2" of airspace at the top. If you have calcium carbonate, add it last, and note that it will cloud the water for hours.
- Say a little prayer as you tighten the cap on the jar.

Step 5 — Seal and store.



- Your biosphere is now complete!
- Place it in a spot with a fairly consistent temperature (70–80°F) and 12–16 daily hours of moderate light.
- Standard room lighting is too dim, and direct sun is too much. A bright north window or a 50W bulb a few feet away are both good, but watch the temperature.
- NOTE: Aquarium fish, shrimps, and snails may be invasive and destructive if released into the environment, so boil or freeze them after the experiment. Or keep them living in an aquarium environment.



This project first appeared in [MAKE Volume 10](#), page 110.

Check out a video of the project at [Make: Online](#).

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